

**What is claimed is:**

1. An optical pulse addition device for demultiplexing/multiplexing a plurality of  
5 time-division multiplexed optical signals in terms of time without converting the optical signals into a plurality of electrical signals, comprising:  
a chirp unit generating a frequency chirp in an inputted optical signal composed of a plurality of  
10 optical pulses and extending a spectrum of the optical pulse;  
a transmission unit transmitting a part of the extended spectrum through a band around a prescribed wavelength; and  
15 an addition unit adding an optical pulse corresponding to the transmitted band to a time-division multiplexed optical signal with the prescribed wavelength.
- 20 2. The optical pulse addition device according to claim 1, wherein said chirp unit is made of a third order non-linear medium.
3. The optical pulse addition device according to  
25 claim 2, wherein said third order non-linear medium is

made of a semiconductor.

4. The optical pulse addition device according to claim 2, wherein said third order non-linear medium is  
5 made of an optical fiber.

5. The optical pulse addition device according to claim 4, wherein the optical fiber is a single-mode fiber,  
in which a non-linear refractive index of a core is set  
10 to a large value and the mode field diameter of which is reduced by performing control of both a specific refractive index difference between the core and a cladding and a core diameter.

15 6. The optical pulse addition device according to claim 5, wherein the non-linear refractive index of the core in the fiber is obtained by doping  $\text{GeO}_2$  to the core and doping fluorine to the cladding.

20 7. The optical pulse addition device according to claim 4, wherein the optical fiber is a dispersion -flat fiber.

8. The optical pulse addition device according to  
25 claim 4, wherein

the optical fiber is a holey fiber.

9. The optical pulse addition device according to claim 4, further comprising:

5 an amplification unit amplifying a strength level of an optical pulse inputted to the optical fiber up to a level such that a prescribed chirp can be generated in the optical fiber.

10 10. The optical pulse addition device according to claim 1, further comprising

an optical branching unit branching a part of a time-division multiplexed signal composed of optical pulses, wherein

15 the part of the branched time-division multiplex signal is inputted to said chirp unit.

11. The optical pulse addition device according to claim 9, wherein a light intensity modulator, an  
20 interferometer type non-linear optical switch or a four-optical wave mixer is used for said optical branching unit.

12. The optical pulse addition device according to  
25 claim 1, wherein said transmission unit has a plurality

of transmission bands.

13. An optical time-division multiplexed apparatus for demultiplexing/multiplexing a plurality of  
 5 time-division multiplexed optical signals in terms of time without converting the optical signals into a plurality of electrical signals, comprising:

a chirp unit generating a frequency chirp in an inputted optical signal composed of a plurality of  
 10 optical pulses and extending a spectrum of the optical pulse;

a transmission unit transmitting a part of the extended spectrum through a band around a prescribed wavelength; and

15 an addition unit adding the optical pulse corresponding to the transmitted band to a time-division multiplexed optical signal with the prescribed wavelength.

20 14. The optical time-division multiplexed apparatus according to claim 12, which increases a multiplex degree of time-division multiplex signals by repeating processes of said chirp unit, transmission unit and addition unit.